Abstract

In any restoration or natural tooth, the surrounding soft-tissue profile plays an integral role in the final esthetics of a case. Similarly in implant restorations, it is no longer sufficient to merely attach a prosthetic device to the underlying fixture, but for optimal esthetics it has become essential for the implant site to be reconstituted in a three-dimensional approach. This invariably involves redevelopment or replacement of lost hard tissue and redevelopment of the correct soft-tissue profile, so that the implant can be placed in the desired position as determined by the restoration, while the soft-tissue profiles are in turn generated by the actual form and contours of the prosthetic device. This article addresses an approach to implant site development.

Restoration-Driven Implant Placement With Restoration-Generated Site Development

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Dental practice is changing exponentially—porcelain laminate veneers, etched porcelain inlays, and even veneer bridges are now predictable restorative modalities. Couple this with innovative new ceramic systems, the ability to effectively bond to enamel or dentin, and osseointegrated implants, and it changes the way we contemplate our approach to and goals for restorative dentistry.

But with this technology comes new horizons. Dentistry has to look beyond simply restoring teeth and contemplate revamping entire smiles and developing a harmonious relationship between the teeth, the soft tissues, and the lips. Surgical plastic procedures have become an integral part of restorative dentistry, as have esthetic implant restorations. From the patients' perspective, dentistry is evolving from the necessities of pain management to esthetic gratification. Today's better-informed and cosmetic-conscious public is increasingly demanding more of us and expecting more from dental materials. We must position ourselves to deliver this total dentofacial harmony.

If, however, an implant is to be an integral aspect of restorative dentistry's day-to-day armamentarium, it must satisfy the same basic esthetic tenets that have become germane to conventional prostheses—in fact, one can no longer use the phrase, "It's an esthetically good result...for an implant." Today, the restoration should be indistinguishable from adjacent natural teeth. The essence of this philosophy is site development.

By definition, a potential implant site comprises two distinct aspects: (1) the hard-tissue osseous component; and (2) the soft-tissue restorative gingival interface.

The reconstitution of both of these aspects is essential to the success of the restoration. The volume of the osseous structure must allow for implant placement in an ideal situation for the restoration, while the anatomic topography of the soft tissue must mimic that of the adjacent teeth. There should be a sufficient volume of soft tissue to develop the restorative emergence profile under cover and to allow for any corrections in cross-sectional form between the head of the fixture and the tooth at the level of the free gingival margin.

The advent of guided bone regeneration using membranes, and the evolution of osseous grafting procedures (the chin graft in par-
ticular), have allowed for restitution of the hard tissue of the implant site. Implants no longer need be placed only where there is bone but rather can be viewed as an extension of the desired restoration.

Periodontal plastic procedures have similarly evolved so that the prosthetic recipient site from which the implant-supported restoration emerges can have a three-dimensional profile identical to the soft tissue around a natural tooth. In fact, the soft-tissue plastic procedures might be regarded as an extension of the philosophy for developing the pontic site for an ovate pontic.

The ability of new ceramic systems to reproduce the natural tooth in all its visible properties—incorporating not just hue, value, and chroma, but also opalescence and fluorescence—has made the discerning factor in the esthetics of an implant-supported restoration the soft-tissue configuration of the recipient site. When evaluating a sagittal cross-section of a tooth, it is evident that the coronal 2 to 3 mm of the free gingival margin is tooth-supported. The coronal aspect of the osseous crest does not extend to the same level as the free gingival margin. The dimensions of the biologic width that comprise the connective-tissue attachment, the epithelial attachment, and the sulcus extend coronally above the osseous level. Thus, the restoration itself becomes intimately involved in the correct development of the soft-tissue profile as the abutment or ceramic system supports this coronal 3 mm of tissue. This is similar to conventional prosthetic restorations, where the restoration or remaining tooth structure is involved in soft-tissue support.

Therefore, the philosophy behind the successful esthetic implant restoration is restoration-driven implant placement.

Restoration-driven implant placement necessitates: (1) developing an adequate volume of osseous structure to support the implant as an extension of the restoration; (2) a sufficient volume of soft tissue to allow for the sculpting of the prosthetic recipient site; and (3) restoration-generated site development, which presumes that the three-dimensional configuration of the prosthesis will have a net effect on the anatomical form of the free-gingival margin, as well as its tone.

The Multifactorial Treatment Process

The treatment planning for a restoration-driven implant placement is a multifactorial process predicated on the esthetic and functional needs of the restoration and invariably necessitating an interdisciplinary team approach.

Evaluate the Esthetic Zone

The esthetic zone has been defined as the area incorporated by the lip perimeter. The relationship of the three components involved in the smile (the teeth, the lips, and the gingiva) determines whether a particular smile has a high, medium, or low lip line, and is deemed to be attractive or not.

The high lip line poses the greatest problem for implant restorations because during smiling, the patient exposes the entire restoration, the restorative gingival frame, the implant/prosthetic interface, as well as the expanse of soft tissue below the inferior border of the upper lip. Everything has to be perfectly redeveloped to fool the observer’s eye.

In the low lip line, the interface between the implant and the restoration is hidden behind the drape of the lip and, therefore, it is not as critical. From an aesthetic perspective, the medium lip line appears to satisfy the needs of today’s cosmetic public. Here, the teeth are visible in their entirety, along with the interdental papillae and a couple of millimeters of the free gingival margin.

Develop the Geometry of Harmony

Within the esthetic zone, the relative position or arrangement of the teeth and the gingival scaffold, as they relate to the lip, must be evaluated. It is desirable to create a certain continuity of form and to establish harmony and symmetry in the smile. The geometry of harmony has been described for the full-denture wearer as follows:

1. the line joining the crests of the free gingival margins should parallel the form of the upper lip;
2. the incisal edges of the maxillary teeth should parallel the form of the lower lip; and
3. the teeth should extend bilaterally to the corner of the smile.

If any deficiencies are not corrected before implant placement, it is possible to end up with an exquisitely esthetic implant-supported restoration, yet an unattractive smile.

Evaluate the Individual Implant Site

The actual implant site must be diagnosed for osseous support, as well as for esthetic soft-tissue components. Esthetic soft-tissue components are similarly three-dimensional. They require:

1. a free gingival margin symmetrical and in harmony with the rest of the arch;
2. a buccolingual contour that simulates the normal root eminence; and
3. the replication of papillae in their pyramidalike form on either side of the restoration. This, then, comprises both the horizontal and the vertical position of each papilla.

If these parameters can be met, the appropriately sized implant fixture can be placed in a predetermined position that will allow for meeting both the esthetic and functional needs of the restoration.

Implant Placement

Implant placement can be classified as being immediate, staged, or delayed with respect to the timing of placement.

1. Immediate Placement

With this procedure, the implant is placed within the confines of the
socket at the time the tooth is extracted. Depending on the size of the extracted tooth and the relative size of the implant, the root diameter will be exceeded by the implant diameter at some point along the length of the root, which together along with the extension of the fixture beyond the root apex allows for primary stability. In the wider, open coronal aspect of the socket, placing a barrier membrane will allow for osseous regeneration.

2. Staged

Here, the tooth is extracted at the first visit and the socket is allowed to heal for at least 8 weeks. This allows for the socket to fill and for soft-tissue closure before the implant is placed. While this procedure necessitates a second visit for implant placement, it allows for primary closure of the flaps and coverage of the membrane.

3. Delayed

By definition, this treatment option indicates that the implant is placed 3 months or more after initial tooth loss. Subsequent to extraction, osseous loss can occur around the socket, resulting in a less-than-ideal topography for implant positioning.

Classification of Implant Sites

In the process of diagnosing and treatment planning for restoration-driven implant placement, it becomes necessary to classify the potential fixture sites to identify or choose the therapeutic modality and/or sequence of therapy. Classifications have been described for both the immediate and delayed implant site.

Immediate Implant Sites

Salama and Salama proposed a classification system for replacing hopeless teeth with implants. The condemned tooth has two definitive zones:

1. The defect environment at the coronal aspect of the tooth that extends from the osseous crest coronally. This is the region where osseous support may have been periodontally compromised.

2. The socket environment that extends apically from the base of the defect towards the root end. In this region, the periodontal relationships are, in fact, still normal and healthy.

Immediate implant sites have three different classifications:

Class I—Immediate Placement

In the Class I extraction, the socket environment predominates so there is potentially less than 5 mm of bone loss on the buccal aspect. This situation typically involves endodontically compromised teeth, root fractures, and trauma where there is no periodontal compromise to the condemned tooth. Concomitant extraction and implant placement usually yield excellent esthetic results.

Class II—Immediate Placement

The Class II receptor site is one where there is a definitive periodontal defect with the potential, after extraction, of a dehiscence on the buccal aspect of greater than 5 mm. The defect aspect at the coronal portion of the root invariably requires attention for implant placement. In these cases, some form of site development is often necessary to locate the head of the implant fixture at the desired level in the correct plane. If there is sufficient primary support for a fixture from the base of the defect apically, regenerative procedures with a membrane will suffice. If the defect is considerably more extensive, osseous grafting may be required.

An alternative solution for some of these cases is the use of orthodontics. If tension can be exerted on the periodontal ligament fibers of the socket aspect, the underlying osseous structure can be modified by bone deposition. If teeth are then extruded incisally through the defect, the socket component of the root moves coronally and provides the potential for bone to regenerate in the previous defect. A change in soft-tissue topography will be concomitant with the change in osseous configuration. The sphere of influence from the orthodontic movement extends at least to the adjacent teeth, when present, or about 8 to 10 mm on either side of the involved root in an edentulous space.

Class III—Immediate Placement

A Class III extraction site is more severely compromised and the defect environment predominates. Before implant placement, this osseous structure usually requires regeneration with membrane technology and/or grafting. Simultaneous placement usually is not possible, necessitating a staged approach.

Delayed Placement Implant Sites

In situations where teeth have been extracted some time previously, classifications have been suggested by Garber as well as Buser and Belser that depend on the resultant form of the extraction site. These classifications relate to the type of reconstruction necessary for correct implant placement and restoration and are extensions of the classifications of edentulous ridges for pontics.

Class I—Delayed Placement

In the Class I defect, there is no...
Class II—Delayed Placement

In Class II restorations, the vertical dimension of the site has not been altered, but there is significant osseous and soft-tissue collapse in a buccolingual direction (Figure 8). There usually appears to be a concavity (Figure 9) in the facial aspect of the proposed implant site as opposed to the usual root prominence that is present on the labial of a natural tooth. When evaluated buccolingly, the osseous form is sufficient for adequate fixture placement (Figure 10) (albeit somewhat lingual) to support the restoration. However, to facilitate a
more esthetic restoration, the implant needs to be placed somewhat more apically to allow for a progressive change in direction between the head of the fixture and the implant axis to unnoticeably take place within the confines of the soft-tissue augmentation. If the implant is placed as conventionally suggested, 3 mm below the adjacent tooth’s cementoenamel junction, or at the coronal crest of the bone, the ridge lap type of pontic becomes necessary. Apical placement of the fixture allows for a gradual transition to take place. However, this necessitates using soft-tissue periodontal plastic augmentation procedures (Figure 11).

Adequate soft tissue must be developed at the coronal aspect of the fixture to create the prosthetic receptor site within which the change in angulation will take place. The roll technique or connective-tissue graft will usually facilitate an esthetic result (Figure 12).

At stage II surgery, a roll technique for pontic sites is performed by extending the uncovering incisions in a palatal configuration from the buccal surface and over the ridge to the lingual. The tissue is further advanced after the deepithelialization and folded in on itself, into a pouch created on the buccal surface of the implant site. This will create the illusion of a restoration with a root eminence developed by the tissue roll resting in the previous concavity.

**Class III—Delayed Implant Placement**

In Class III situations (Figures 13 and 14), the vertical change remains inconsequential, but the buccal loss is greater. In many of these cases, there may be sufficient bone for the placement of an implant at some angle, but it will invariably be in an inadequate position for a functional or esthetic restoration. It is necessary to place the implant ideally as determined by the needs of the restoration (regardless of whether some threads are exposed) and use bone regeneration procedures with membranes to obtain coverage. In Class III cases, it is critical that most of the implant be anchored in pre-existing bone. The regenerated bone should not be relied on to provide primary support to the implant, but merely to obtain coverage. It will also be necessary to use soft-tissue plastic procedures to develop the prosthetic recipient site.

**Class IV Defects—Delayed Implant Placement**

In Class IV cases, both the vertical and horizontal components of the site have been lost. A “staged” approach is necessary for reconstruction of the hard- and soft-tissue components of the potential site, with a combination of multiple osseous grafts or “J-shaped” grafts used to restore both the vertical and horizontal aspects of the bone loss. Secondary procedures will be required for soft-tissue reconstruction of the site.

In a Class I, II, or III case, the implant placement and any necessary
Second-Stage Procedures

Some type of second-stage soft-tissue procedure is invariably necessary for optimal esthetics. In this second stage of implant reconstruction, the goal is to use a provisional restoration that has the optimal form of the desired restoration and to develop the configuration of the restorative gingival interface and the prospective prosthetic recipient site. Depending on the type of implant system used, the coronal 3 mm of soft tissue is being supported by the implant, the abutment, or the restoration, which must have an emergence profile to support the tissue in the desired configuration. To facilitate this, an impression (Figure 15) should be taken at implant placement so that the relationship of the implant to the adjacent teeth can be transferred to a working cast. Using this working cast, the provisional restoration is ideally constructed in the laboratory and is ready for second stage surgery. The provisional has a critical area between the head of the implant and the free gingival margin. This is the transitional transmucosal zone where the desired change in axis and horizontal translation is gradually accomplished. The greater the discrepancy between the ideal position of the restoration and the actual position of the implant, the deeper the implant head will need to be to allow for the transition to take place—if an esthetic restoration is the goal. However, it should be noted that the deeper the head of the fixture the greater the potential for bacterial peri-implantitis and fistula formation. Also, the greater the off-axis loading, the greater the potential for component failure.

Hence, increased esthetics at the expense of inadequate hard-tissue site development may result in an enhanced risk for secondary problems.

At the time of the second-stage procedure, if it becomes evident that there is insufficient soft tissue available to create the desired form of the prosthetic recipient site, it may be necessary to use a three-stage approach (Figure 16). In this technique, a modified-stage, healing abutment or an overscrew of sufficient height to correct the soft-tissue discrepancy is placed (Figure 17) and the tissue is advanced via a flap procedure over the healing abutment, closing the area. The dead space that is created between the flap and the underlying bone in the tenting process will form a blood clot, will organize, and ultimately will become an integral part of the soft-tissue site-development process (Figure 18).

A third surgical procedure is then necessary to actually place the
provisional restoration (Figure 19). At this stage, any further buccal plumping of the recipient site can be done via the use of a soft-tissue connective-tissue graft, when placed on the labial aspect of the osseous defect, or by using the roll technique described above (Figures 20 and 21).

The mesiodistal contours and width of the provisional will determine the shape and height of the interdental papillae (Figures 22 and 23), while the buccolingual prominence of the provisional will develop the accurate form of the free gingival margin (Figure 24). This is referred to as restoration-generated site development as the final form of this tissue is predicated on the shapes and contour of the restoration (Figure 25).

Only after the soft-tissue profiles are comparable to those of natural teeth can the final restoration be placed. A host of different esthetically derived abutments now exists for the various types of implant systems. But irrespective of the abutment and ceramic used, the essence of any esthetic implant restoration remains initial site development. Site development involves hard- tissue corrective procedures, for optimal implant placement, and soft-tissue plastic procedures that provide adequate soft tissue and facilitate developing the restorative gingival interface within the prosthetic recipient site. Therefore, the key to the esthetic implant is restoration-driven implant placement with restoration-driven site development.

**Selected Readings**